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Grid-Tie Rotating Solar Rooftop System using PIC Microcontroller

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Abstract
As the non-renewable energy resources are decreasing, use of renewable resources for producing electricity is increasing. Solar panels are becoming more popular day by day, this project is based on a pic. This controller controls the solar panel by rotating it according to the position of sun. These energy from the solar panel is then stored in battery which is then used to power the home or office. The remaining energy is then returned to the power station through the grid tie system. Hence with the help of these project lots of Power consumption will be reduced. The photo voltaic cell generates the reveres effect of diode as light falls on the photodiode a voltage is generated across these diodes. The number diodes are in series called array then these arrays are in parallel. So, the forms the standard wattage panel. Generated ac will be connected to main grid through net meter system. So, when our demand is less generated supply will pass to grid rotating meter in reverse direction. As our demand increases at night time meter will rotate in forward direction so we call it as the net meter system
Keywords: *PV Systems, Grid-Tied PV Systems, Solar Energy, Rooftop PV Systems, Residential PV Systems.*

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I. INTRODUCTION

All solar power systems work on the same basic principles. Solar panels first convert solar energy or sunlight into DC power using what is known as the photovoltaic (PV) effect. The DC power can then be stored in a battery or converted by a solar inverter into AC power which can be used to run home appliances. Depending on the type of system, excess solar energy can either be fed into the electricity grid for credits, or stored in a variety of different battery storage systems [8]. Most modern solar panels are made up of many silicon **(**PV cells) which generate direct current (DC) electricity from sunlight**.** The PV cells are linked together within the solar panel and connected to adjacent panels using cables. *Note*: It is sunlight or irradiance, not heat, which produces electricity in photovoltaic cells. Solar panels, also known as solar modules, are generally connected together in 'strings' to create a what is known as a solar array. The amount of solar energy generated depends on several factors including the orientation and tilt angle of the solar panels, efficiency of the solar panel, plus any losses due to shading, dirt and even ambient temperature. There are many different solar panel orders to export energy back into the grid [5]. On grid systems make sense for locations with no daytime power cut or with less than 2 hrs. of daytime power cut. This type of system is apt for reducing your electricity bills since it is cheaper than a battery-based system and there is no recurring cost of replacement of components.

For many years, solar energy has been used for direct heating in residential applications, such as water heaters and solar cooking. PV systems have also been used to generate electricity for remote locations, where the grid power is not available. After that, PV systems were installed on rooftops of buildings, and were connected to the grid to reduce the dependence on utility companies [2-4]. It seemed feasible to do so with large buildings; however, in recent years, PV systems have been widely used across the globe for residential homes, where the output power is little, but large enough to reduce the electric bill [5, 6]. Other solar systems used for residential applications include hybrid systems, such as combined heat and power systems [7] and wind-PV residential

systems [8]. Most of these systems are directly connected to the grid, and see the entire home as one bulk load. This paper presents a small photovoltaic system model, which supplies electricity to residential applications to reduce the dependence on the power utility company and reduce the electric bill. This is achieved by designing and building active system to provide electric power to small loads that would simulate real household applications. The power delivered to the loads is controlled by a microcontroller, which determines whether a certain load would be powered by the PV system or the utility company. The microcontroller would measure the available amount of power generated by the photovoltaic system, and based on that, it would determine how many loads could be powered by the system. To maximize the power output of the PV system, a sun follower system is designed and built for the PV cells to allow them to capture more perpendicular sunrays. Figure 1 shows the block diagram of the presented residential PV system.

Increasing Energy demands in the recent years have been seen to be growing at an exponential rate by the commercial and as well as domestic markets. While the non-renewable resources are rapidly getting depleted, it leaves with no other option but to use renewable resources to produce usable energy as well as saving some amount of money With this paper we can save money on our power bill, increase the value of your home or office and reduce our carbon footprint without losing the security of the public power grid.

II. BLOCK DIAGRAM

To activate the microcontroller unit ac supply of 230/12 volt is used. Rectifier converts ac voltage into pulsated dc voltage. Regulator converts it into constant dc source. Microcontroller unit synchronizes the generated ac supply with grid. According to load meter will rotate into forward and reverse direction.

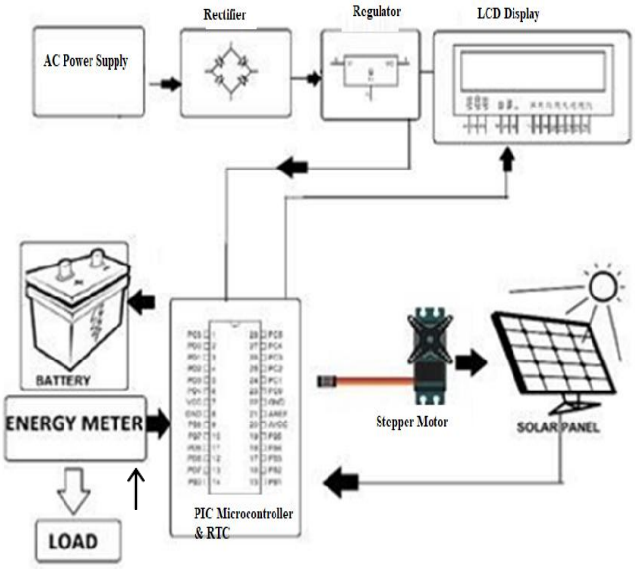


Fig. 1. Block diagram of the presented residential PV system

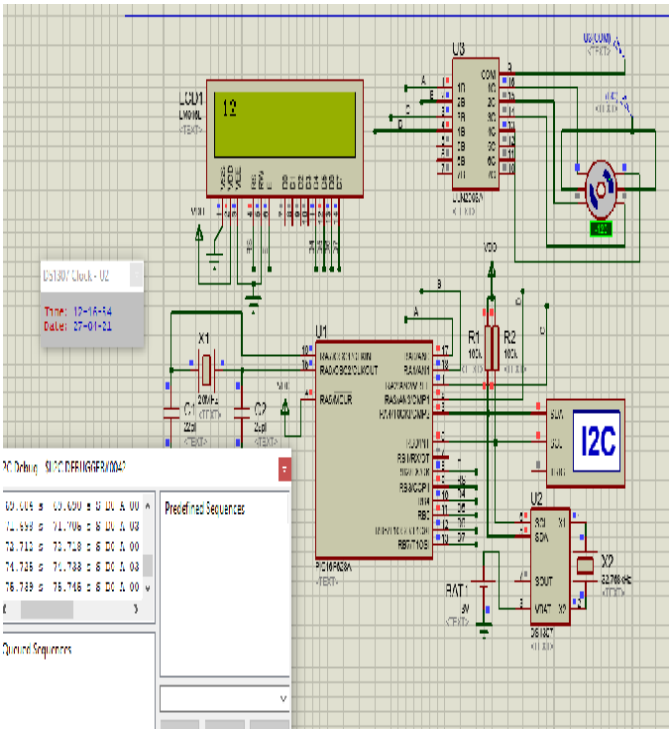


Fig. 2. Simulation Diagram of the system

To rotate solar panel towards sun at maximum energy level. It uses the RTC clock, after each 2 hours it rotates with 30-degree angle with the help stepper motor. It achieves 5 position in a day and it comes to original position

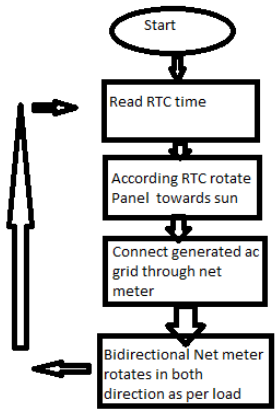
2.1. Sun-Tracker Design

Solar plates are mounted GS structure. This structure is rotated by using stepper motor. To receive maximum energy from solar RTC clock is used. Initial by default timing is 8 am . when RTC time becomes 10 am it rotates by 30 degree towards sun. then on 12, 2pm, 4pm, 6pm and on 7 pm it comes to initial position. In this way tracker works

2.2. Microcontroller Circuit Design

The microcontroller IC used was the PIC 16f628a.for tracking purpose RTC is used. and is used to monitor the sunrays. After each 2 hours solar plate rotates towards sun. the microcontroller also generates ac voltage. Microcontroller first checks the timings from RTC ic according to timing it will rotate to the panel by using stepper motor. It connects the generated ac supply to the grid. According to load demand net meter will rotate forward and reverse.

2.3 Flowchart



III. SYSTEM OPERATION AND FINDINGS

Once the solar generation starts, the generated energy is first consumed by the loads. Once the load requirement is satisfied, the remaining energy will be exported to the grid. Grid by itself acts as a virtual battery taking in all the excess energy that has been exported. This is known as banking of energy. During the night, when there is no solar, the loads can import the banked energy. Similarly, when there is less generation from solar due to cloudy conditions, the required energy is imported from the grid. At the end of every billing cycle, the export and import billing will be calculated and this net will be calculated with the help of a Bi-directional meter. Difference between the traditional Unidirectional meter and the Bi-directional meter is that the unidirectional meter only displays the total energy imported from the grid. However, Bi-directional meter records 3 readings – the total amount of energy Exported (in kWh), total amount of energy Imported, and Net energy difference of the export and import.

Sample Code:

```
/*  Name     : main.c
 *  Purpose  : Main file for DS1307 RTC interfacing with PIC16F628A.
 *  Author   : Mane
 *  Date     : 31-03-21
 *  Revision : None
 */
#include "Includes.h"

// Config word
__CONFIG(FOSC_HS & WDTE_OFF & PWRTE_ON & MCLRE_ON & BOREN_ON & LVP_OFF &
CPD_OFF & CP_OFF);
void MSdelay(unsigned int val)
{
    unsigned int i,j;
      for(i=0;i<val;i++)
         for(j=0;j<165;j++);
}

// Main function
void main()
{
        InitLCD();          // Initialize LCD
        InitI2C();          // Initialize i2c pins

        // Set initial time
//      Set_DS1307_RTC_Time(AM_Time, 12, 40, 59);       // Set time 12:40:59 AM

        // Set initial date
//      Set_DS1307_RTC_Date(31, 3, 14, Monday);           // Set 31-03-2014 @ Monday

        while(1)
        {
                // Display RTC time on first line of LCD
                DisplayTimeToLCD(Get_DS1307_RTC_Time());

                // Display RTC date on second line of LCD
                DisplayDateOnLCD(Get_DS1307_RTC_Date());

                __delay_ms(1000);          // 1 second delay

        }
}
```

IV. CONCLUSION

This paper presented gives the information about how solar energy is converted into ac voltage source and connected to net meter system so meter will rotate in both the directions. As well as solar plates rotate towards the direction of sun according RTC used IC. Solar plates will rotate to maximum energy direction of

solar after each 2 hours. So it will generate maximum efficiency of solar system. This will be beneficial to all society peoples to encourage them to install solar on grid system.

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